Varroidae, A New Family of Mites on Honey Bees (Mesostigmata: Acarina)

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ABSTRACT

The mite *Varroa jacobsoni* Oudemans, a parasite of honey bees in Asia, is redescribed and figured; *Euvarroa sinhai,* n. gen., n. sp., also a parasite of honey bees, is described and figured from India; both are from Asia. The family *Varroidae* is erected for the two genera.

The genus *Varroa* was proposed by Oudemans (1904a, b) to accommodate a laelapid-like mite found parasitizing *Apis indica* Fabricius in Java. Although the male was unknown, Oudemans did not hesitate to place this mite in the Laelaptinae because "the female, concerning the dorsal and ventral shields, seems to be nearest to *Hypoaspis myrmemophilus* (Berlese) and *Hypoaspis Canestrini* (Berlese) which are provided too with metapodial as well as with inguinal shields, a rare coincidence; and concerning its being covered dorsally with so numerous hairs,—*Hypoaspis arcualis* (C. L. Koch)." Baker and Wharton (1952) subsequently listed *Varroa* in the subfamily Hypoaspidinae (Laelapidae) and it has not until now been removed from that group.

Upon further examination of the mites infesting honey bees in Southeast Asia we noted that *Varroa jacobsoni* Oudemans (type-species of *Varroa*) showed characteristics that do not fit the present concept of Laelapidae. The discovery of the new genus *Euvarroa* provides us additional support for assigning these mites separate family status under the present classification.

In distinguishing Varroidae from other Mesostigmata, especially the Dermanyssidae-Laelapidae group *sensu* Evans and Till (1965), we considered Oudemans' diagnostic bases for the genus *Varroa* as the major features for characterization of the group, namely the marked modification in the structure of the chelicerae which completely lack the fixed digit, and the number and arrangement of the gnathosomal setae. However, Oudemans (1904b: 216) misinterpreted the cheliceral structure: ". . . that the mandibles in the female sex lack the upper-jaw and have a fixed, not a movable, under-jaw." We are including in this diagnosis other features important in differentiating Varroidae from other groups, especially the palpus and leg chaetotaxy. An interesting feature of the leg and palpus chaetotaxy is the reduction in number of setae compared with those of the Dermanyssidae-Laelapidae group *sensu* Evans and Till (1965).

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Family **Varroidae**, n. fam.

Type-genus: *Varroa* Oudemans (1904a b).

The 2 genera included in this family are parasites of wild and domestic honey bees in Southeast Asia, India, Korea, Japan, and the Soviet Far East. They have been collected on dead and live pupae, on adult bees, and in comb-cells and sealed brood.

The females are readily distinguished from other members of the Mesostigmata by the marked modifications in the structure of the chelicerae which completely lack the fixed digit, and by the number and arrangement of the gnathosomal setae. The stigmata and peritreme are situated ventrolateral; the peritreme is short and strongly looped and directed posteriorly or laterally in the region of coxa IV. The tined setae on the palps are 2-pronged, with the basal prong markedly reduced in size. The body is strongly sclerotized with a single dorsal plate covered with a dense pattern of setae. The form of the tritosternum, sternal region and genital-ventral plate shows an affinity to the Laelapidae-Dermanyssidae group, and the arrangement of the gnathosomal setae is the type seen in the Trachytoidea or Uropodoidea. However, the reduction in the number of gnathosomal setae and the structure of the chelicerae are unique; the latter has lost many of the characteristics of the basic dermanyssid type as given by Evans and Till (1966).

Female.—Relatively large, hairy. Chelicerae short, simple; fixed digit completely lacking; movable digit dentate; slender, almost pointed, without setae, evidently developed for piercing and tearing the skin of the hosts. Corniculi slender, tapering distally and blade-like dorsally. Three pairs of gnathosomal setae present, namely: 1 pair at base of gnathosoma and 2 pairs on hypostome. Tectum if visible simple, with smooth anterior margin. Dorsal plate entire, covering entire dorsum, with narrow thickened margin and ornamented with polygonal network of simple lines or striations and covered with dense pattern of setae which may be simple or barbed, the marginal setae distinctly differing in size from discal setae. Tritosternum if present weak, bifurcate. Sternal plate well developed and bearing 3 pairs of setae, except in *Varroa* which has 5 or 6 pairs. Genital plate with more than 10 setae, the posterior extension approaching anterior margin of ventrianal plate. Anal plate bearing 3 setae; anus terminal. Peritremal plate absent, or possibly fused with podal plates. Podal plates (Evans and Till, 1965) well developed, half circling posterior border of coxae IV; metapodal plates present and markedly developed in *Varroa*. Stigmata and peritreme ventrolateral in position; peritreme strongly looped and extending laterally or posteriorly from stigmata. Exopodal plates curiously developed in *Varroa* but weak in *Euvarroa*. Legs strongly formed; II-IV 7-segmented, and with metatarsus; claws if present not well developed.

Genus Varroa Oudemans

Varroa Oudemans, 1904a (July 1), Entomol. Ber. (Amst.) 18: 161; 1904b (July), Notes Leyden Mus. 24: 216.

Type-species: *Varroa jacobsoni* Oudemans, 1904; by monotypy.

This remarkable genus with 1 species (the type *V. jacobsoni*) has the following features in the female: 3 pairs of gnathosomal setae; deutosternal groove smooth, lacking denticles; exopodal plates completely fused with each other anteriorly; podal or endopodal and metapodal plates markedly developed, the latter densely setate; ventral plate covered with dense pattern of setae; sternal plate with 5–6 pairs of setae and 4–5 pairs of pores; stigmata and peritreme ventro-lateral. Peritreme strongly looped and directed laterad of stigmata; peritremal plates lacking or presumably fused with podal plates; dorsal plate entire with a narrow thickened margin, covered with dense smooth and finely barbed setae; legs II-IV 7-segmented. The male is similar to the female but poorly sclerotized; the spermatodactyl is absent and it is possible that the modified strongly grooved chelicerae function as spermatophore bearers.

Varroa is placed close to *Euvarroa*, n. gen. by the structure of the chelicerae, by the number and arrangement of gnathosomal setae and by the lack of peritremal plates. The main differences between the genera appear to be the presence of denticles in the deutosternal groove and the absence of sternal pores in *Euvarroa*. However, there are other differences, especially in the palpus and leg chaetotaxy which will be discussed in the species descriptions.

Varroa jacobsoni Oudemans

Varroa jacobsoni Oudemans, 1904a (July 1), Entomol. Ber. (Amst.) 18: 161; 1904b (July), Notes Leyden Mus. 24: 216 (as *jacobsonii*). Type-loc.: Samarang, Java, on *Apis indica* Fabricius.

Varroa ricinus Oudemans, 1904c, Entomol. Ber. (Amst.) 19: 169. *Nomen nudum*.

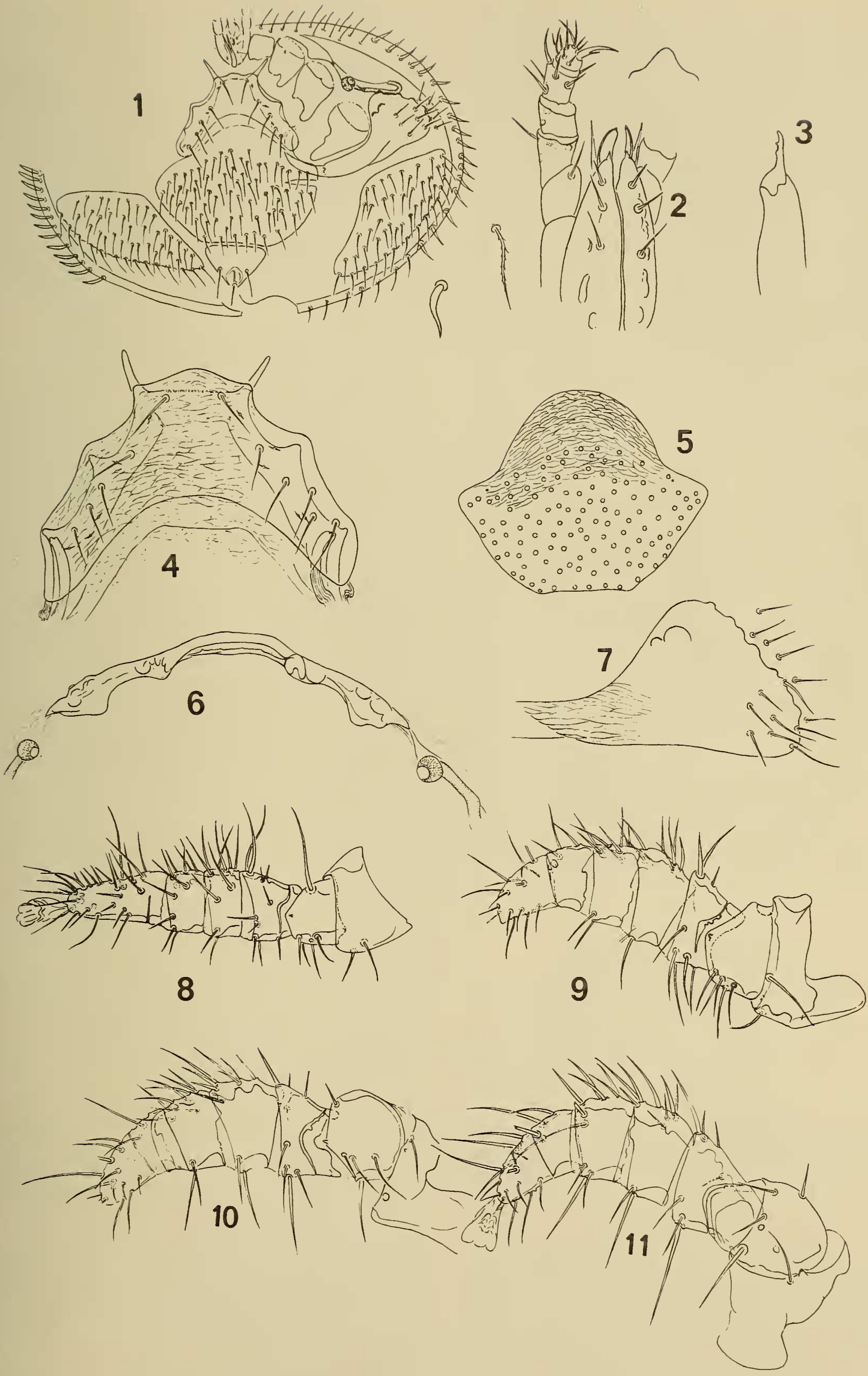
Myrmozercon reidi Gunther, 1961, Proc. Linn. Soc. N.S.W. 76: 155. Type-loc.: Singapore, Malaya, on *Apis indica* Fabricius; Delfinado, 1963, J. Apic. Res. 2: 113. Synonymy.

Female.—Large, brown, hairy species; body broadly elliptical, dorsum completely covered by sclerotized plate; surface of dorsal plate covered with numerous finely barbed setae of varying lengths, discal setae shorter than posterior and lateral setae; ornamented with striations and polygonal network of simple lines; a narrow thickened margin broadened antero-laterally, dorsally bearing short setae, 21–23 stout lanceolate setae at each side as figured. Gnathosoma small, completely hidden beneath dorsal plate, lying between coxae I. Cheliceral bases relatively short, slender; chelicerae short, fixed digit absent, movable digit slender, tapered distally and bearing 2 small teeth, without setae, as figured. Deutosternal groove smooth, without denticle. Tectum as figured, smooth anteriorly. Corniculi blade-like, appearing flat in profile. Salivary stylets present, hyaline and tapering. Three pairs of gnathosomal setae arranged in longitudinal row; 2 pairs of short setae on hypostome, a pair at base of gnathosoma slightly longer than hypostomals. Palpus 6-segmented; tarsal tined seta with short, small basal prong. Palpal chaetotaxy formula as follows: the figures represent trochanter, femur, genu, tibia and tarsus: 1, 2–3, 2, 7–8, 12. Number of setae on femur and tibia variable. Sternal plate with strong internal ridges, extending from anterior margin of coxae II to coxae IV; very long anterior protuberance between coxae I and II; 5–6 pairs of sternal setae and 4–5 pairs of pores present; 3 pairs of pores situated between setae 1 and 2 (pore 1), 2 and 3 (pore 2), 3 and 4 (pore 3), pore 4 laterad or below seta 5. Metasternal plate obviously fused with sternal plate. Genital opening located below sternal plate and difficult to see unless specimens dissected. Ventral plate wider than long, uniformly sclerotized, covered with numerous setae (over 100) except anterior portion; posterior extension straight and approaching anterior margin of anal plate. Anal plate small, bearing 3 setae; paranals situated on each side of anus; with 1 post anal. Anus terminal. Metapodal plates conspicuous, subtriangular and very large, occupying the greater portion of area below lateral plates, completely covered with setae. Endopodal plates (Evans and Till, 1965) greatly enlarged, arising ventrally from posterior region of sternal plate half circling posterior margin of and extending laterally beyond region of coxae IV; lateral portion greatly expanded with strong ridges or protuberances and with 5–8 setae; adjacent integument with 5–8 setae. Exopodals strong, completely fused with each other anteriorly and forming a framework along anterior border of dorsal plate, enclosing the cavities between coxae I and II, II and IV. This structure is best seen in dissected specimens, as figured. Stigmata and peritreme ventro-lateral, stigmata located in region of coxae III and IV; peritreme short, strongly looped distally, extending posteriorly from stigmata in region of coxae IV. Legs robust, 7-segmented with metatarsi present on II-IV although tarsi I show slight evidence of secondary division. Claws do not appear developed. Leg chaetotaxy formula as follows: the figures represent coxa, trochanter, femur, genu, tibia, metatarsus and tarsus. Number of setae on genu, tibia and tarsus of leg IV somewhat variable.

Leg I — 2, 5, 10, 12, 13, 0, 34
Leg II — 2, 5, 8, 11, 11, 4, 13
Leg III — 2, 5, 8, 11, 11, 4, 13
Leg IV — 1, 6, 7, 9–11, 10–11, 4, 12–13

Body length 1135 μ; width 1666 μ.

Male.—Gnathosoma as in female; deutosternal groove without teeth; with 3 pairs of setae in longitudinal line; cheliceral bases as in female, fixed chelae lacking, movable chela broadly tapered to blunt tip and deeply grooved its entire length; corniculi blade-like as in female; palpal tine claw with tiny basal prong. Tritosternum weakly sclerotized, bifurcate. Genital opening anterior; sternal plate weakly sclerotized, with 5 pairs of setae; venter of plate posterior to coxae IV area with numerous short setae. Stigmata and peritreme ventral-lateral, situated between coxae III and IV and directed anteriorly. Endopodal plates present, weak, half circling coxae IV; other plates not or barely discernable; anal plate with 3 pairs of setae. Dorsal plate weakly sclerotized, striated, covered with numerous simple setae, the posterior marginal setae being stronger than others but not as much as in female. Body oval, broadest at coxae IV area. Legs robust, coxae I-IV contiguous as in female, tarsal claws not developed. Body length 800μ; width 706μ.



Varroa jacobsoni Oudemans. Fig. 1, venter of female with details of dorsal setae; fig. 2, venter of gnathosoma with tectum; fig. 3, chelicera; fig. 4, sternal plate; fig. 5, genital plate; fig. 6, exopodal plate; fig. 7, endopodal plate; fig. 8, leg I; fig. 9, leg II; fig. 10, leg III; fig. 11, leg IV.

V. jacobsoni has been found parasitizing *Apis indica* Fabricius, *Apis mellifera* Linnnaeus and *Apis cerana javana* Enderlein in Southeast Asia, India and the Soviet Far East; males were recently found in Swon, Korea by K. S. Woo on *Apis mellifera* (Crane, 1968; Delfinado, 1963; Ehara, 1968; Gupta, 1967; Kshirsagar, 1967; Kulikov, 1965; Stephen, 1968; Yoshikawa and Ohgushi, 1965). Kulikov (1955) cited a number of interesting observations concerning the biology and behavior of this mite on bees. Although the mites freely occur on the back surface and under the wings of the bees, feeding takes place on the abdomen "with their mouthparts in the area of the intersegmental membranes whereby the anterior part of the body is hidden below the chitin segment of the bees' abdomen" (translation from the Russian). Apparently the mites suck tissue fluid or haemolymph of the host, but Kulikov suggested that the mites possibly also feed on the regurgitated content of the honey sac. He further observed that *jacobsoni* is viviparous. It is possible that they give birth to first stage nymphs. But we have not observed any intrauterine development in the specimens on hand. The mites chiefly affect drone brood, and up to 5000 individuals may be found in one colony.

Genus **Euvarroa**, n. gen.

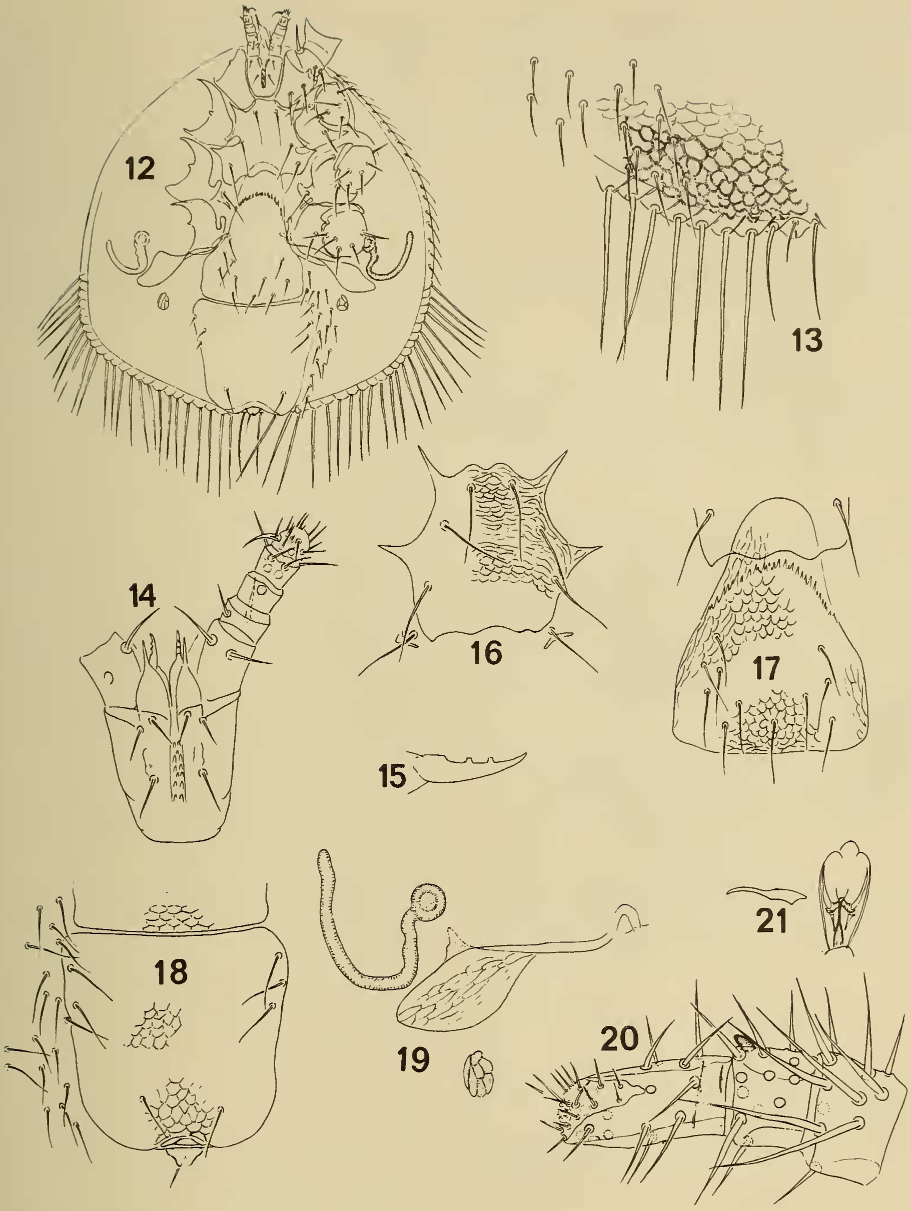
Type-species: *Euvarroa sinhai*, n. sp.

This new genus is similar to *Varroa* by the structure of the chelicerae which lack the fixed digit, by possessing three pairs of gnathosomal setae and by the form and location of the stigmata and peritreme. It obviously differs in that the deutosternal groove possesses 13–14 small triangular denticles.

Female.—Dorsal plate covered with moderately dense simple setae of nearly uniform length, ornamented with reticulate pattern; a narrow lightly thickened margin, broader posteriorly, bearing 39–40 very long lanceolate setae; sternal plate rectangular with thickened anterior and lateral margins, with three pairs of setae lacking associated pores; a pair of metasternal setae lies outside plate just above remnants of the metasternal plates; metapodal plates small, rounded; podal plates half circle posterior border of coxae IV; exopodal plates very lightly sclerotized. Stigmata and peritreme ventro-lateral, stigmata situated adjacent to coxae IV, peritreme strongly looped and directed laterad of stigmata in region of coxae IV. Peritremal plates absent or possibly fused with podal plates. Legs well developed, with stout setae, II-IV 7-segmented; claws simple, developed. Laciniae and tritosternum not seen, probably absent. Forked tine of palpus possesses a tiny basal prong. Palpal and leg chaetotaxy formula as given for species.

Euvarroa sinhai, n. sp.

Female.—Moderately large, brown setaceous mite, body broadly pear-shaped, dorsum completely covered by single sclerotized entire plate; surface of dorsal plate covered with moderately dense simple setae of almost uniform length, ornamented with reticulate pattern, a lightly thickened margin present, broader posteriorly and bearing 39–40 very long lanceolate setae dorsally on individual protuberances as figured; other marginal setae small and dorsal. Gnathosoma small, completely hidden below dorsal plate. Cheliceral bases short; chelicerae short, modified as in *V. jacobsoni*, fixed digit completely lacking; movable digit with 2 large teeth and tapering to pointed tip. Corniculi short, blade-like, salivary stylets well developed. Deutosternal groove with 2–3 uneven rows of small triangular denticles. Three pairs of gnathosomal setae present, with hypostomal setae 2 outside line between hypostomal 1 and gnathosomal setae as figured (the position of 2 may vary); gnathosomal setae longer than hypostomals. Tritosternum not seen. Tectum not seen. Palpal tined seta with tiny basal prong as figured. Palpal chaetotaxy formula as follows, the figures representing trochanter, femur, genu, tibia and tarsus: 2, 2–3, 1–2, 5, 12; setal numbers may be variable. Sternal plate rectangular, extending from posterior margin of coxae I to coxae III, with strong protuberances between cavities of coxae I and II and III, with thickened anterior and lateral margins, with 3 pairs of sternal setae lacking associated pores; a pair of metasternal setae lies outside sternal plate just above remnants of metasternal plate between region of coxae III and IV; associated metasternal pore also missing. Genital plate large, pear- or flask-shaped with straight posterior margin approaching anterior margin of anal plate, bearing 9–10 setae, uniformly sclerotized except anterior portion as figured. Anal plate large, larger than ventral plate, squarish with shallow median indentation at posterior margin; 2 paranals longer and stronger than post anal seta. Anus terminal, hyaline or membranous. About 26 pairs of setae on integument adjacent to anal and ventral plates, 2 or 3 pairs of setae may be situated on anal plate. Metapodal plates small, rounded, without setae. Podal plates



Euvarroa sinhai, n. sp. Fig. 12, venter of female; fig. 13, details of posterior dorsal margin; fig. 14, venter of gnathosoma; fig. 15, chelicera; fig. 16, sternal plate; fig. 17, genital plate; fig. 18, anal plate; fig. 19, endopodal plate, peritreme and small metapodal plate; fig. 20, tarsus, tibia and genu of leg I; fig. 21, ambulacra of leg I.

small, subtriangular, half circling posterior border of coxae IV, without setae. Stigmata and peritreme ventro-lateral; stigmata situated adjacent to coxae IV; peritreme strongly looped and directed laterad of stigmata in region of coxa IV. Peritremal plates absent, probably fused with podal plates. Exopodal plates very lightly sclerotized, enclosing cavities of coxae I-IV and continuing anteriorly as in *V. jacobsoni*. Legs short, strong, II-IV more robust than I; coxal and dorsal setae stronger and stouter than others; legs II-IV 7-segmented, tibia I with a short, strong antero-dorsal spur; claws developed, simple. Leg chaetotaxy formula as follows: the figures represent coxa, trochanter, femur, genu, tibia, metatarsus and tarsus. Compared with *V. jacobsoni* the chaetotaxy of *E. sinhai* shows a reduction in number of setae in trochanters I-III and femur and genu IV. This overall deficiency in leg chaetotaxy of both *E. sinhai* and *V. jacobsoni* is an interesting feature not well known in the Dermanyssidae-Laelapidae group.

Leg I — 2, 3, 10–12, 11, 12–13, 0, 37
Leg II — 2, 3, 10, 10, 10, 3, 12
Leg III — 2, 4, 5, 10, 10, 3, 12
Leg IV — 1, 6, 4, 8, 10, 3, 12

Body length 1040 μ, width 1000 μ.

Male.—Unknown.

Holotype.—Female, U. S. National Museum No. 3580, taken from colony of *Apis florea* Fabricius, New Delhi, India, August 28, 1971, by R. B. P. Sinha.

Paratypes.—Nine females in the U. S. National Museum collection; the Acarology Laboratory, Ohio State University, and the New York State Museum and Science Service, Albany, New York; all with the data of the holotype.

This species is named for Dr. R. B. P. Sinha of New Delhi, India.

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